PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2004-225920**
(43)Date of publication of application : **12.08.2004**

(51)Int.Cl. **F25B 9/00**
C09K 5/08

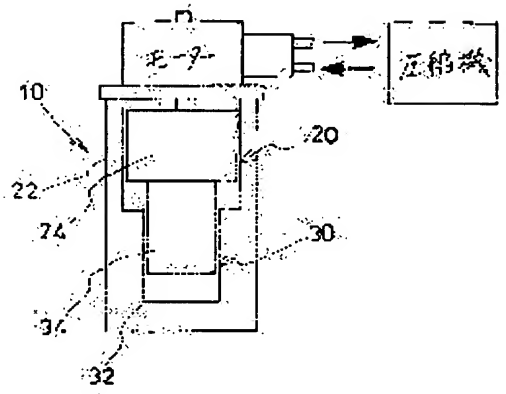
(21)Application number : **2002-364041**
(22)Date of filing : **16.12.2002**

(71)Applicant : **AISIN SEIKI CO LTD**
(72)Inventor : **YAGI WATARU**
MIZUTANI UICHIRO

(30)Priority
Priority number : **2002344333** Priority date : **27.11.2002** Priority country : **JP**

(54) COOL ACCUMULATOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a cool accumulator applying a Pb-free cold storage material.
SOLUTION: In this cool accumulator for a very low temperature refrigeration machine in which the cold storage material 34 is packed, the cold storage material 34 includes one or both of In and Bi as its main components, and at least one of Sn, Ag, Au, Pt, Nb, Zr, Sr, Al, Si, B, C, O, Ca, Ba, La and other materials of low environmental load as additives.



LEGAL STATUS

[Date of request for examination] 25.11.2005

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision

of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]
Regenerator which contains either or the both sides of In and Bi for said cold reserving material as a principal component, and comes to produce an ingredient with few environmental loads of Sn, Ag, Au, Pt, Nb, Zr, Sr, aluminum, Si, B, C, O, calcium, Ba, and La and others at least one as add-in material in the regenerator for very-low-temperature refrigerators with which the cold reserving material was filled up.
[Claim 2]
About said ingredient, it is the predetermined configuration powder or the regenerator according to claim 1 which it comes it spherical to carry out of the diameter of 0.01-1mm preferably with the approach of atomization, grinding, and others.
[Claim 3]
It is the regenerator according to claim 1 which becomes as [become / 0.01-2mm thickness] preferably about said ingredient by making it the shape of tabular, the shape of a thin film, and a flake.
[Claim 4]
They are reticulated or the regenerator according to claim 1 considered as the punching block so that an opening may be preferably set to 0.01-1mm in said ingredient.
[Claim 5]
Said add-in material is regenerator according to claim 1 which is 20 or less % of the weight preferably.
[Claim 6]
In the regenerator for very-low-temperature refrigerators with which the cold reserving material was filled up said cold reserving material Either or the both sides of In and Bi is contained as a principal component. Sn, Ag, Au, Pt, Nb, Zr, Sr, aluminum, Si, B, C, O, calcium, Ba, The cold reserving material section by the side of the elevated temperature which comes to produce an ingredient with few environmental loads of La and others at least one as add-in material, Regenerator made into the laminated structure more than two-layer [which consists of the cold reserving material section by the side of PrAg and the low temperature produced from the charge of a cold reserving material of rare earth metal content of Er3nickel and others which has a high specific heat peak or less by 10K].

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the regenerator especially used for refrigerators, such as a Stirling style, the GM (GIHODO McMahon packing) type, and a pulse tubing type, about the regenerator into which the large cold reserving material of the specific heat was filled up with low temperature.
[0002]
[Description of the Prior Art]
As everyone knows, in refrigerators, such as a Stirling style, the GM (GIHODO McMahon packing) type, and a pulse tubing type, the regenerator into which the large cold reserving material of the specific heat was filled up with low temperature serves as an indispensable component from a viewpoint of improvement in refrigerating capacity. A deer is carried out, this regenerator takes and carries out accumulation of the heat from the compressed working medium which flows to an one direction, and the gas stored in the working medium which flows to the opposite side, and which expanded is transmitted.
[0003]
Conventionally, as a cold reserving material with which it fills up in regenerator, alloys, such as lead, are used abundantly (for example, patent reference 1 reference.). However, in the cold reserving material which consists of lead, since a subject [the specific heat of a grid system], although the 40K or more specific heat is large, the 20K or less specific heat in very low temperature becomes small too much. When the regenerator with which such a cold reserving material was filled up is used within a refrigerator (especially refrigerator of a multistage type), it becomes impossible therefore, to fully transmit heat to the working medium which could not fully absorb heat from the compressed working medium, and expanded in the very-low-temperature field before and behind 20K. Consequently, in the refrigerator which uses the regenerator with which said cold reserving material was filled up, there was a trouble of the ability not to make very low temperature reach. Furthermore, it has a thin meaning that the use of the viewpoint of an environmental problem to lead of being set as the object of regulation is inevitable, and uses a lead alloy as a raw material of a cold reserving material sooner or later also practical.
[0004]
Then, as regenerator proposed in order to solve the above-mentioned trouble, it is Er3 not only with the specific heat of a grid system but the magnetic specific heat. There are some with which the cold reserving material of the magnetic substance which consists of nickel was filled up (for example, patent reference 2 reference.). This thing is 20K. Since it is larger than the cold reserving material which that specific heat becomes from copper or lead by the following very low temperature, in 20K or less (less than [Especially 10] K) very low temperature, cool storage effectiveness can be improved rather than the cold reserving material which consists of lead.
[0005]

[Patent reference 1]
The patent No. 3293446 official report (the two - 7th page, drawing 1 - drawing 7)
[0006]
[Patent reference 2]
JP,7-101134,B (the two - 6th page, drawing 1 - drawing 4)
[0007]
[Problem(s) to be Solved by the Invention]
However, Er3 Since many rare earth elements are included, the cold reserving material of the magnetic substance which consists of nickel cannot be practically used so much because of cost quantity. Moreover, Er3 Since a magnetic transformation point (that is, phase transition of a magnetic condition) is in the 8K neighborhood in the cold reserving material which consists of nickel, although the specific heat is large less than 10K, in 10-30K, it becomes small. For this reason, although cool storage effectiveness becomes high in less than 10K very low temperature, as for cool storage effectiveness, 10-30K are insufficient. This means practically that it is inapplicable from a cost side in the refrigerator which generates refrigeration of 10-30K.
[0008]
so, this invention -- ** -- Pb without fault [like] -- let it be a technical technical problem to offer the regenerator using a free cold reserving material.
[0009]
[Means for Solving the Problem]
The means provided in order to solve the above-mentioned technical problem In the regenerator according to claim 1 for very-low-temperature refrigerators with which "cold reserving material was filled up like regenerator which contains either or the both sides of In and Bi for said cold reserving material as a principal component, and comes to produce an ingredient with few environmental loads of Sn, Ag, Au, Pt, Nb, Zr, Sr, aluminum, Si, B, C, O, calcium, Ba, and La and others at least one as add-in material. " -- it is having constituted.
[0010]
[Embodiment of the Invention]
[Operation gestalt 1]
While dissolving 832g (4Ns) (90at%) of indium grains, and 168g (4Ns) (10at%) of bismuth grains with the high frequency induction furnace under argon atmosphere, slushing the part into the mold and making it the letter of a block, the remaining parts (molten metal) were passed to the body-of-revolution transit side of the rotational speed of 10000 k/S, atomization powder was produced, and it adjusted to the diameter of 0.15-0.3mm after classification.
[0011]
The cold reserving material produced as mentioned above is the organization where BiIn2 of a some was mixed with In so that clearly from the In-Bi binary-condition Fig. shown in drawing 1 .

[0012]
Subsequently, the specific heat of the cold reserving material of a sample which started and acquired the block produced by the above-mentioned approach was measured by the continuation insulating method using germanium thermometer. In here, the continuation insulating method is the approach of setting the specific heat to deltaC for the value broken by temperature-change deltaT when adding Joule's heat deltaQ to a sample (here ingot) continuously under heat insulation conditions. This volume ratio heat measurement result is shown in drawing 2 .
[0013]
Er3 as a cold reserving material which contains a rare earth metal besides Pb as a cold reserving material, or the specific heat of Cu as comparison material in drawing 2 The specific heat of compounds, such as nickel, PrAg, and HoAg, is written together. Although it is lower than the specific heat of Pb a little, since heat conduction is several times higher, the specific heat of the cold reserving material of the operation gestalt 1 is considered to be an abbreviation

EQC so that I may be clearly understood from drawing 2 . Moreover, the specific heat of the cold reserving material of the operation gestalt 1 is Er3. It exceeds also to nickel or the specific heat of PrAg in the place exceeding 15K. Moreover, it exceeds notably the specific heat of the cold reserving material of the operation gestalt 1 also to the specific heat of the ingredient slack Cu of a cold reserving material like Pb.

[0014]

It measured using what changed the GM type refrigerator (specifically Aisin Seiki Co., Ltd. to "GA-08A" the GM type refrigerator marketed by the part number) of 2.8kW output with the structure where the refrigerating capacity of the above-mentioned ingredient is shown in drawing 5 . This GM type refrigerator 10 is equipped with the 1st step regenerator 20 and the 2nd step regenerator 30. In the cylinder 22 made from a bakelite, the 1st step regenerator 20 carries out the restoration and the laminating of the copper net 24 of 180 meshes, and is formed. In the cylinder 32 made from a bakelite, the 2nd step regenerator 30 is filled up with the above-mentioned ingredient 34, and is formed. Manganese covered wire is wound as heater wires by the low-temperature side edge section of the cylinder 22 of the 1st step regenerator 20, and the cylinder 32 of the 2nd step regenerator 30, and it enabled it to set an input heating value as arbitration by performing energization control to this manganese covered wire. That is, it is used for the temperature control of the heater wires wound around the low-temperature side edge section of the cylinder 22 of the 1st step regenerator 20. When the GM type refrigerator was operated steadily with the heat input below the calorific value of the heater wires wound around the low-temperature side edge section of the cylinder 32 of the 2nd step regenerator 30, the calorific value concerned and magnitude of the heat input concerned were considered as operating temperature and a frozen output, respectively. The stroke of each regenerator is set up with 24mm.

[0015]

The temperature dependence exerted on the refrigerating capacity of development material, and comparison material and the conventional material at drawing 3 is shown. less than [about 10K] -- the refrigerating capacity of development material, and the refrigerating capacity of the comparison material Pb -- abbreviation -- although it is the same, the former exceeds the latter, when 10K are exceeded. Moreover, the refrigerating capacity of development material exceeds the refrigerating capacity of Er3nickel of the conventional material or more by 20K, and exceeds the refrigerating capacity of PrAg of the conventional material or more by 15K, respectively. The refrigerating capacity of development material has exceeded the refrigerating capacity of Cu overwhelmingly in the total-temperature range. Carry out a deer, and in the present GM type refrigerator, although the thing of the form which carries out the laminating of the Pb with the specific heat which doubled the regenerator of the 2nd step with the temperature distribution is making the mainstream from a viewpoint of the specific heat and cost Since the refrigerating capacity of development material exceeds the refrigerating capacity of Pb as shown above, and since the cost of development material is cheaper than a rare earth ingredient, it can expect practically that development material can substitute Pb as a cold reserving material of the regenerator of the 2nd step.

[0016]

[Operation gestalt 2]

897g (90 % of the weight) of in JUMU grains and 103g (10 % of the weight) of tin grains were set to the RF fusion furnace like the operation gestalt 1, this mixture was dissolved in the argon gas ambient atmosphere, and the cold reserving material of in God and atomization powder was produced. The In-Sn two-dimensional state diagram shown in drawing 4 shows that this cold reserving material is the organization of the condition of Abbreviation In. ** -- the specific heat of the cold reserving material produced like was measured, and it was shown in drawing 2 . Since it is judged that refrigerating capacity comparable as the cold reserving material of the operation gestalt 1 is shown, the cold reserving material of this operation gestalt 2 can be practically used effectively as an elevated-temperature side ingredient of the regenerator of the 2nd step.

[0017]
moreover, a degree of hardness as a result of measuring the degree of hardness of the ingredient of the operation gestalt 2, in case In is 100 % of the weight -- about -- a degree of hardness in case Hv1.1 and In are [90 % of the weight and Sn] 10 % of the weight -- about -- a degree of hardness in case Hv2.1 and In are [85 % of the weight and Sn] 15 % of the weight -- about -- it was Hv2.5. A deer is carried out, since a degree of hardness in case Pb is 100 % of the weight is about 3.2 abbreviation Hv, the reinforcement of the cold reserving material of the operation gestalt 2 becomes a thing near the reinforcement of Pb, and it is judged practically that it is equal.
[0018]
[Operation gestalt 3]
As shown in drawing 6 , the cold reserving material was made into the laminated structure which consists of part II which consists of 50% of the weight of PrAg fine particles located in a part I [which consists of 50% of the weight of In90Sn10 located in an elevated-temperature side as a configuration which secures high heat capacity at the temperature of each part of regenerator], and low temperature side. Then, although lost at this invention block diagram under very low temperature, the cooling property of an abbreviation EQC is acquired under Er3nickel which has a track record conventionally, and very low temperature so that clearly from a graph as shown in drawing 7 . In addition, the PrAg fine particles which carry out one-sheet insertion close [of the stainless steel of 200 meshes] between the wire gauzes of one pair of copper of 200 meshes, constitute a reticulated sandwiches object, and constitute part II as it is also with this reticulated sandwiches object may be divided into two, and working medium may be rectified.
[0019]
[Effect of the Invention]
According to this invention, the regenerator using Pb free-lancer's cold reserving material which presents the refrigerating capacity of extent for which the conventional cold reserving material slack Pb can be substituted can be obtained.
[Brief Description of the Drawings]
[Drawing 1] In-Bi binary-condition Fig.
[Drawing 2] In-Sn binary-condition Fig.
[Drawing 3] The graph which shows the temperature dependence of the volume ratio heat of development material, and the conventional material and comparison material.
[Drawing 4] The graph which shows the temperature dependence which the refrigerating capacity of development material, and the conventional material and comparison material does.
[Drawing 5] The block diagram of the GM type refrigerator.
[Drawing 6] The configuration conceptual diagram of the example 3 of an embodiment of this invention.
[Drawing 7] The graph which shows the temperature dependence which the refrigerating capacity of development material (example 3 of an embodiment), and the conventional material and comparison material does.
[Description of Notations]
10 GM Type Refrigerator
20 1st Regenerator
22 Cylinder of 1st Regenerator
30 2nd Regenerator
32 Cylinder of 2nd Regenerator
33 Cold Reserving Material

[Translation done.]

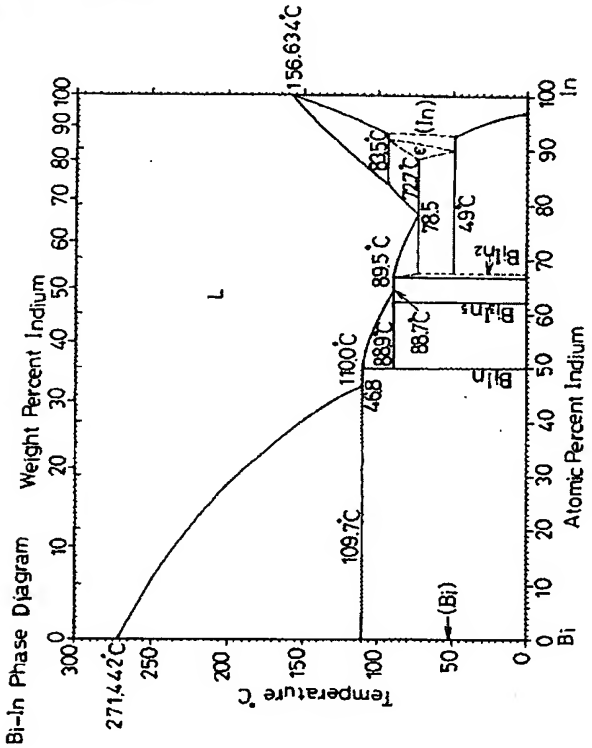
* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

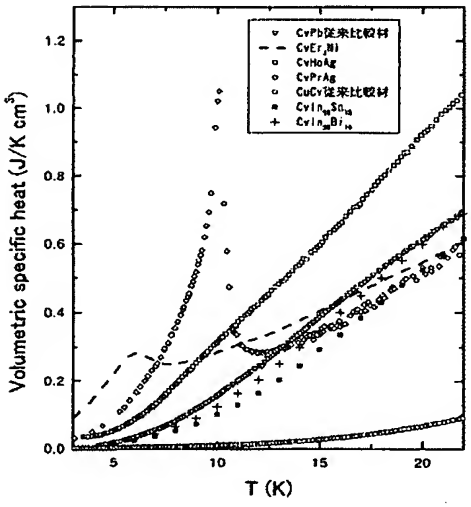
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

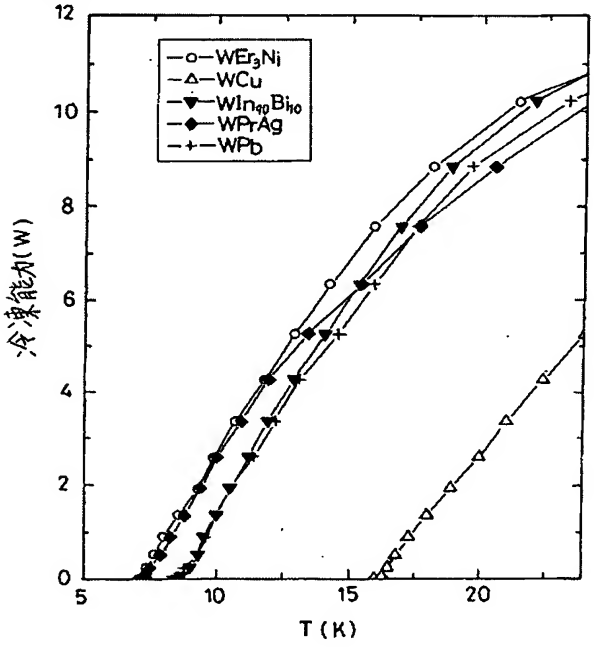
[Drawing 1]



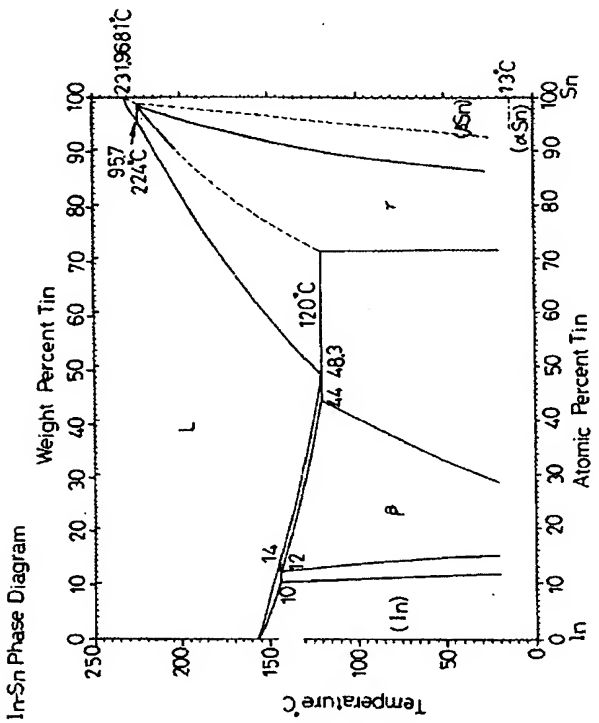
[Drawing 2]



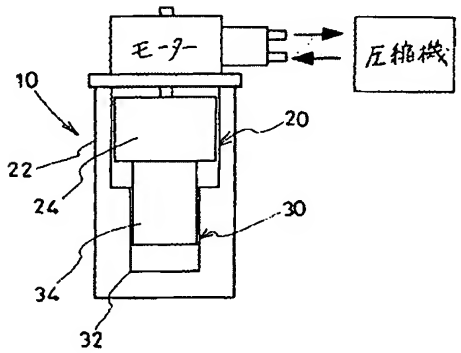
[Drawing 3]



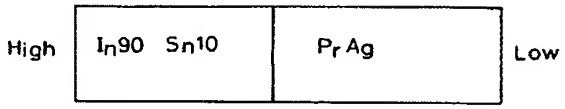
[Drawing 4]



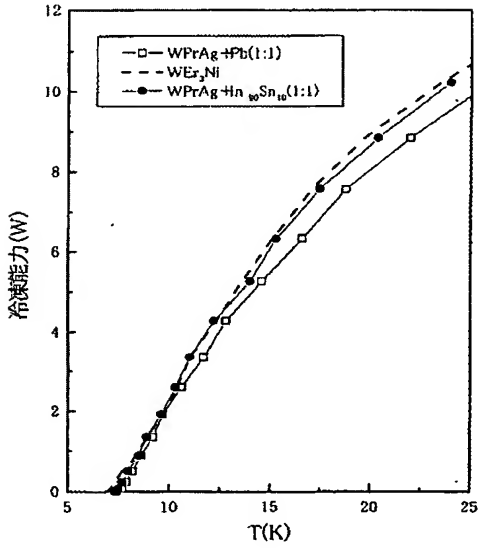
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]